STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

POPULATION STRUCTURE, MIGRATORY PATTERNS AND HABITAT REQUIREMENTS OF THE ARCTIC GRAYLING

by

Jerome E. Hallberg

ALASKA DEPARTMENT OF FISH AND GAME
Ronald O. Skoog, Commissioner

SPORT FISH DIVISION
Rupert E. Andrews, Director

TABLE OF CONTENTS

STUDY NO. R-I DISTRIBUTION, ABUNDANCE AND NATURAL HISTORY OF THE ARCTIC GRAYLING IN THE TANANA DRAINAGE
By: Jerome E. Hallberg

Job No. R-I-A Population Structure, Migratory Patterns and Habitat Requirements of the Arctic Grayling

	Page
Abstract	1
Background	1
Recommendations	2
Research	2
Management	2
Objectives	4
Techniques Used	4
Findings	4
Population Estimates	4
Length and Age Structure	6
Development Projects Affecting the Chena River	12
Literature Cited	15

Volume 20 Study No. R-I

RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska

Project No.: F-9-11

Study No.: R-I Study Title: DISTRIBUTION, ABUNDANCE AND NATURAL HISTORY OF THE ARCTIC GRAYLING IN THE TANANA DRAINAGE

Job No.: R-I-A Job Title: Population Structure, Migratory Patterns and Habitat Reauirements of the Arctic Grayling

Period Covered: July 1, 1978 to June 30, 1979

ABSTRACT

Population estimates of Arctic grayling, *Thymallus arcticus* (Pallas), greater than 150 millimeters fork length, conducted on four sections of the lower 80 kilometers (50 miles) of the Chena River in 1978 showed a decrease in the two lower sections while the upper two sections for the third successive year showed an increase. The average estimated population of the four combined areas is 200 grayling per kilometer (320 grayling per mile). Grayling in the four sections were predominantly immature in that 98 percent were less than 270 millimeters (10.5 inches) fork length. Of the three highest age classes represented Age Class II with 38.0 percent of the sample was the predominant age followed by Age III with 22.0 percent, and Age IV representing 20.9 percent of the sample. Age II grayling had a mean fork length of 167 millimeters (6.5 inches) while the mean length of all age groups combined (n=268) was 188 millimeters (7.5 inches). Complete data on age and length composition of fish sampled during population estimates on the lower Chena are presented.

BACKGROUND

The Chena River is a rapid runoff stream originating in the Tanana Hills 144 km (90 mi) east of Fairbanks at latitude 65°10'N, longitude 144°45'W. It flows in a westerly direction for approximately 240 km (150 mi) and drains an area of 3,168 km^2 (1,980 mi^2) before emptying into the Tanana River 11.2 km (7 mi) below the City of Fairbanks.

The maximum measured flow of the Chena River occurred in the August, 1967, flood when a measured 2,107 cms (74,400 cfs) was recorded. Minimum flows of around 5.66 cms (200 cfs) have also been recorded.

The Chena Hot Springs Road, which parallels the Chena River from km 41.6 (mi 26) to its terminus at km 96 (mi 60), crosses the river seven times, providing easy access for fishermen and recreationists alike. Also within this area the State of Alaska, Division of Parks, has recently appropriated 101,174 ha (250,000 a) to be used as a recreation area. The Amy Corps of Engineers is presently constructing a flood control project on the Chena River at river km 75.6 (mi 47). The project is due for completion in 1980 and is designed to channel flood waters from the upper Chena River directly into the Tanana River, bypassing the City of Fairbanks and the lower Chena, thus protecting both from damaging flood waters.

With the expected increased use of the Chena River due to the development of the recreation area and improved access, along with ongoing construction projects such as the flood control structure, it becomes important that we keep abreast of the ever fluctuating numbers of Arctic grayling, *Thymallus arcticus* (Pallas), in what is the heaviest fished grayling stream in Alaska.

The river was divided into 17 sections (Fig. 1); from these, four index sections were selected and population estimates were made to determine changes in the population structure.

Standard mark and recapture methods to estimate grayling numbers were initiated by Roguski and Winslow (1969), and continued by Roguski and Tack (1970), Tack (1971 through 1976), and tiallberg (1977-1978).

lnformation obtained during the population estimates also includes length frequencies, age and length composition, and annual survival rates, all of which aid in understanding grayling life history.

RECOMMENDATIONS

Research

It is recommended that:

1. Population estimates on index sections of the Chena River should be continued.

2. Investigations should continue on spring-fed streams and headwaters of major river systems in the Tanana drainage.

3. A new index section should be selected to serve as a control section in the population estimates.

Management

Monitoring of development projects affecting the Chena River should be continued.

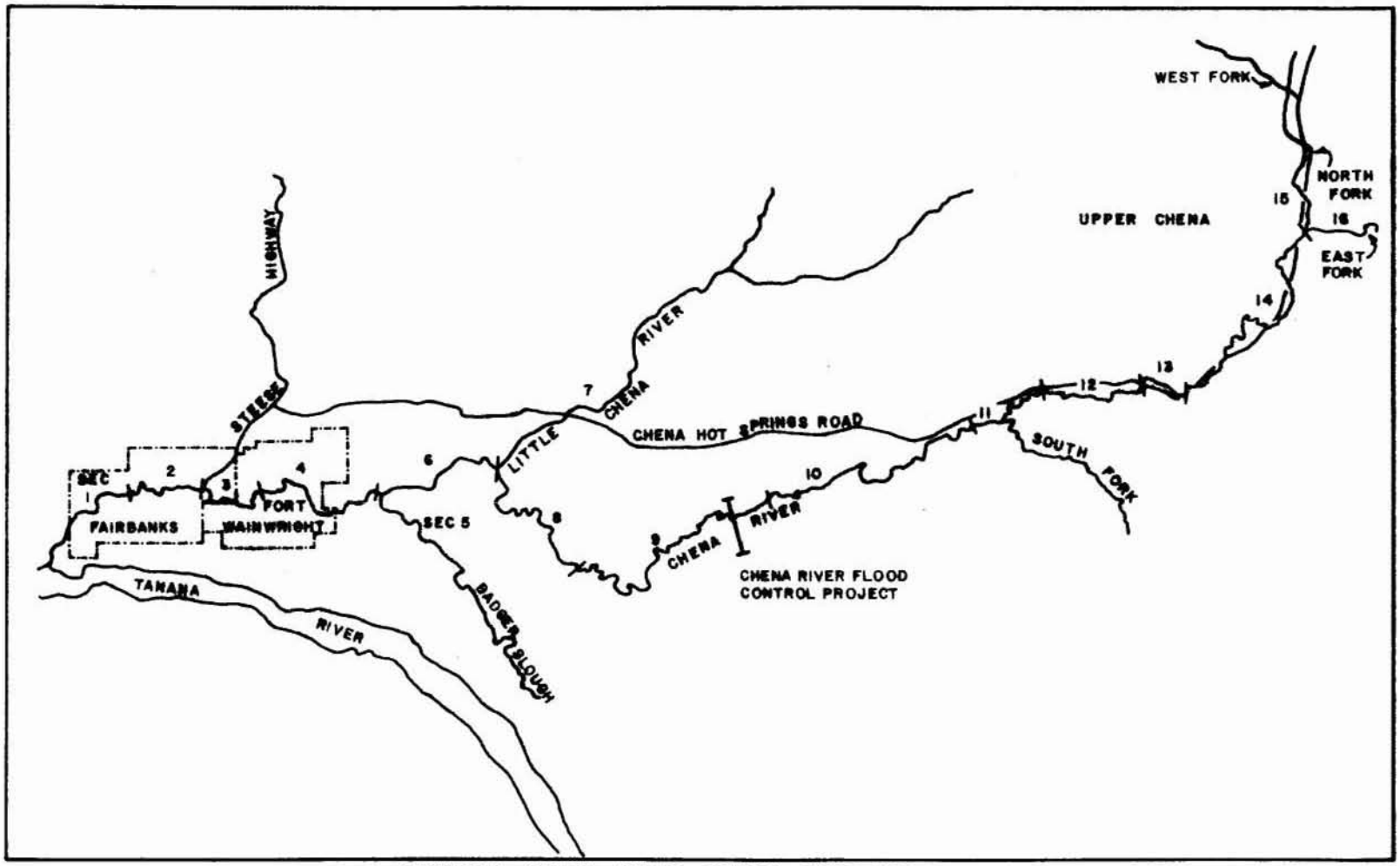

FIGURE I. CHENA RIVER STUDY SECTIONS

OBJECTIVES

1. Determine Arctic grayling populations and age class structure in index sections of the Chena River.

2. To keep abreast of the development projects affecting the fish habitat of the Chena River and other tributaries of the Tanana drainage.

TECHNIQUES USED

The Chena River sections referred to in this report are the same as in previous years, and are repeated here for convenience (Table 1, Fig. 1)

Grayling for population and length composition studies were captured hy a boat-mounted clectrofishing unit described by Van Hulle (1968) and Roguski and Winslow (1969). Passes were made through each section on three successive days and grayling greater than 150 mm fork length were marked by punching a small hole through the dorsal fin.

Population estimates were made using the techniques of the Schumacher-Eschmeyer and Schnabel, as described in Ricker (1958).

Grayling scales used for age determination were individually cleaned and mounted on 20 mil acetate using a Carver press at 20,000 psi, heated to 93.3°C (200°F) for 30 seconds. The scales were read on a Bruning 200 microfiche reader.

FINDINGS

Population Estimates

Grayling population estimates were conducted in Sections 2a, 2b, 6, and in the area just above the Chena River Lakes Flood Control Project presently being constructed at river km 70 (mi 44 to 47) (Fig. 1). Section 2, which lies adjacent to Fairbanks, and the area near the dam site, which will be directly impacted during times of flooding due to the impoundment of water, are both critical areas needing yearly information. Section 6, is a 4.8 km (3 mi) section of the Chena River located between the mouths of Badger Slough and the Little Chena River. This area, because it had not been exposed to heavy development or angling pressures in the past and is easily accessible, has been considered as the reference section in our estimates. This, however, is changing due to the many construction and development projects in the area. Some have been completed, such as the Trans-Alaska Pipeline which crosses the Chena River in Section 6, the continuation of Nordale Road, and the installation of a bridge, boat launch, and wayside area just above the section, making access much easier. Many new homes are also being built along the Chena within this section contributing to increased activity and use. Other proposed

Table 1. Chena River study sections.

Section Number	Section Name	River Miles*	Section Length km	mi
1	River Mouth to University Ave.	0-6 (0-9.7)	9.7	6.0
2a	University Ave. to Peger Road	6-8 (9.7-12.9)	3.2	2.0
Zb	Peger Road to Wendell Street	8-11 (12.9-17.7)	4.8	3.0
3	Wendell St. to Wainwright Railroad Bridge	11-14.5 (17.7-23.3)	5.6	3.5
4	Wainwright Railroad Bridge to Badger Slough	14.5-21.5 (23.3-34.6)	11.3	7.0
5	Badger Slough		26.6	16.5
6	Badger Slough to Little Chena	21.5-24.5 (34.6-39.4)	4.8	3.0
7	Little Chena River		99.0	61.5
8	Little Chena to Nordale Slough	24.5-31 (39.4-49.9)	10.5	6.5
9a	Nordale Slough to Bluffs	31-55.5 (49.9-89.3)	39.4	24.5
9b	Bluffs to Bailey Bridge	55.5-63 (89.3-101.4)	12.1	7.5
10	Bailey Bridge to Hodgins Slough	63-79 (101.4-127.1)	25.7	16.0
11	ttodgins Slough to 90 Mi. Slough	79-90 (127.1-144.8)	17.7	11.0
12	90 Mi. Slough to First Bridge	90-92 (144.8-148.0)	3.2	2.0
13	First Bridge to Second Bridge	92-94.5 (148.0-152.1)	4.0	2.5
13	Second Bridge to North Fork	94.5-102 (152.1-164.1)	12.1	7.5
15	North Fork of Chena River		56.3	35.0
16	East Fork of Chena River		99.8	62.0
17	West Fork of Chena River		56.3	35.0

* km in parentheses

plans affecting Section 6 include sub-divisions, more roads, and a marina catering to riverboats and float planes. A new, less exploited section of the river may be needed for use as a control section.

Results of 1978 population estimates are presented in Table 2, and a summary of population estimates conducted on these four index sections of the Chena River from 1968 to 1978 appear in Table 3.

It should be noted that in Table 3, population estimates prior to 1973 were based on all sizes of grayling captured, while the estimates from 1973 to 1978 are only from grayling 150 mm (6 in) and larger. This change was made because 150 mm fish (6 in) (Age III and up) are readily captured by electrofishing and are considered to be representatively sampled while smaller fish are not representatively captured. Length frequency data collected during population estimates from 1970 through 1972 (Tack, 1970-1972), were analyzed to determine what percentage of the sample used in the estimates were of grayling smaller than 150 mm (6 in). 'These results appear in Table 4, and show that 22 to 48% of the samples represent the smaller size grayling,, thus reducing population estimates significantly.

Estimates in 1978 show a decrease in grayling populations in the lower two sections and an increase in the upper two sections. The estimate in Section 2a shows the second lowest number of grayling 69 per km (110 per mi) in 7 years, while Section 2b indicates the lowest 162 per km (259 grayling per mi) ever recorded in that area. Tack (1971), hypothesized that fluctuations in the grayling population may be the result of increases or decreases in the abundance of invertebrate life, and that the number of invertebrates is related to eutrophication from domestic sewage discharged into the lower river. Prior to July, 1976, approximately 3.0 million gallons of sewage was added to the lower river daily; however, the City of Fairbanks and Fort Wainwright are now hooked up to the new sewage disposal plant which empties into the Tanana River. It is not known at this time if this change-over had any effect on the levels of invertebrate life in the lower Chena, but the fact that both areas show a marked decrease in grayling numbers in the past 2 years while the two areas upstream show a slight increase, may .indicate a relocation of these lower river grayling. This however, is just a theory. More study is needed to better understand what is happening with the lower Chena River grayling.

Length and Age Structure

The length frequency distribution of the 1,111 grayling captured by electrofishing in Sections 2a, 2b, 6, and the area near the dam site during the 1978 population studies appears in Figure 2. The mean fork length of grayling captured in these four areas was 181 mm (7 in). The peak of the length distributions occurred between 150 (6 in) and 190 mm (7.5 in) (45% of total). The length frequency in percent of sample in each individual section appears in Table 5. A comparison of these figures with those computed in 1977 (Hallberg, 1978), shows that

Table 2. Grayling population estimates in four sections of the Chena River, 1978

River Section	Date	Length of Section km	Length of Section mile	Schnabel Estimate GR/km	Schnabel Estimate GR/mi	Schumacher-Eschmeyer Estimate GR/km	Schumacher-Eschmeyer Estimate GR/mi	90% Confidence Limits Schumacher-Eschmeyer GR/km
2a	July 14-17	3.2	2	65	104	69	110	44-156
2b	July 25-28	4.8	3	158	254	162	259	148-179
6	July 10-13	4.8	3	216	346	226	361	210-243
Dam Site km 71-76	Aug. 8-11	4.8	3	309	495	345	553	333-359

Table 3. Grayling population estimates* for various sections of the Chena River, 1968-1978.

River Section	Year**	Dates	GR/km	GR/mi
2a	1971	Aug. 30 - Sept. 3	681	1,095
	1972	June 22-26	414	666
	1973	July 20-23	291	469
	1974	June 26-28	55	89
	1975	July 19-21	257	413
	1977	July 5-8	318	511
	1978	July 14-17	69	110
2b	1968	. . .	681	1,095
	1969	. . .	1,175	1,890
	1970	July 2-10	1,532	2,465
	1971a	June 2-7	2,024	3,257
	1971b	Aug. 8 - Sept. 3	2,325	3,741
	1972	June 22-26	914	1,471
	1973	July 3-14	422	679
	1974	June 25-28	399	642
	1976	July 22-24	406	654
	1977	July 11-14	318	511
	1978	July 25-28	162	259
	1968	. . .	281	452
	1969	. . .	567	913
	1970	May 26-30	478	769
	1971	June 21-24	366	589
	1972	June 19-20	206	331
	1973	July 16-17	242	389
	1974	Aug. 13-15	86	138
	1975***	July 10-14	190	306
	1976	July 28-30	163	262
	1977	July 18-22	173	278
	1978	July 10-13	226	361
9a at Dam Site (km 71-76)	1972	June 27-29	1,134	1,824
	1973	July 18-19	497	800
	1974	July 9-11	259	416
	1976	Aug. 4-6	304	489
	1977	July 26-30	315	507
	1978	Aug. 8-11	344	553

* Population estimates prior to 1973 were based on all grayling captured while estimates from 1973 to the present are only for fish 150 mm (6 in), in length or larger.

** Data prior to 1976 from Tack (1976)

*** Only 63 fish used in this estimate - results should be regarded with caution.

Table 4. Adjusted population estimates for 1970–1972 for grayling larger than 150 mm based on fork length frequency data.

River Section	Year	Recorded Pop. Est. GR/km	Recorded Pop. Est. GR/mi	Calculated Percent < 150 mm	Adjusted Pop. Est. GR/km	Adjusted Pop. Est. GR/mi
2a	1971	681	1,095	44.0	300	613
	1972	414	666	25.5	309	497
2b	1970	1,532	2,465	40.0	919	1,479
	1971	2,325	3,741	44.0	1,302	2,095
	1972	914	1,471	33.5	608	978
6	1970	478	769	22.0	373	600
	1971	366	589	48.4	189	304
	1972	206	331	22.9	159	255
Dam Site	1972	1,134	1,824	28.4	812	1,306
				34.3% Average		

Fig. 2. Length Frequency of Grayling Captured by Electrofishing from Sections 2a, 2b, 6, and Dam Site.

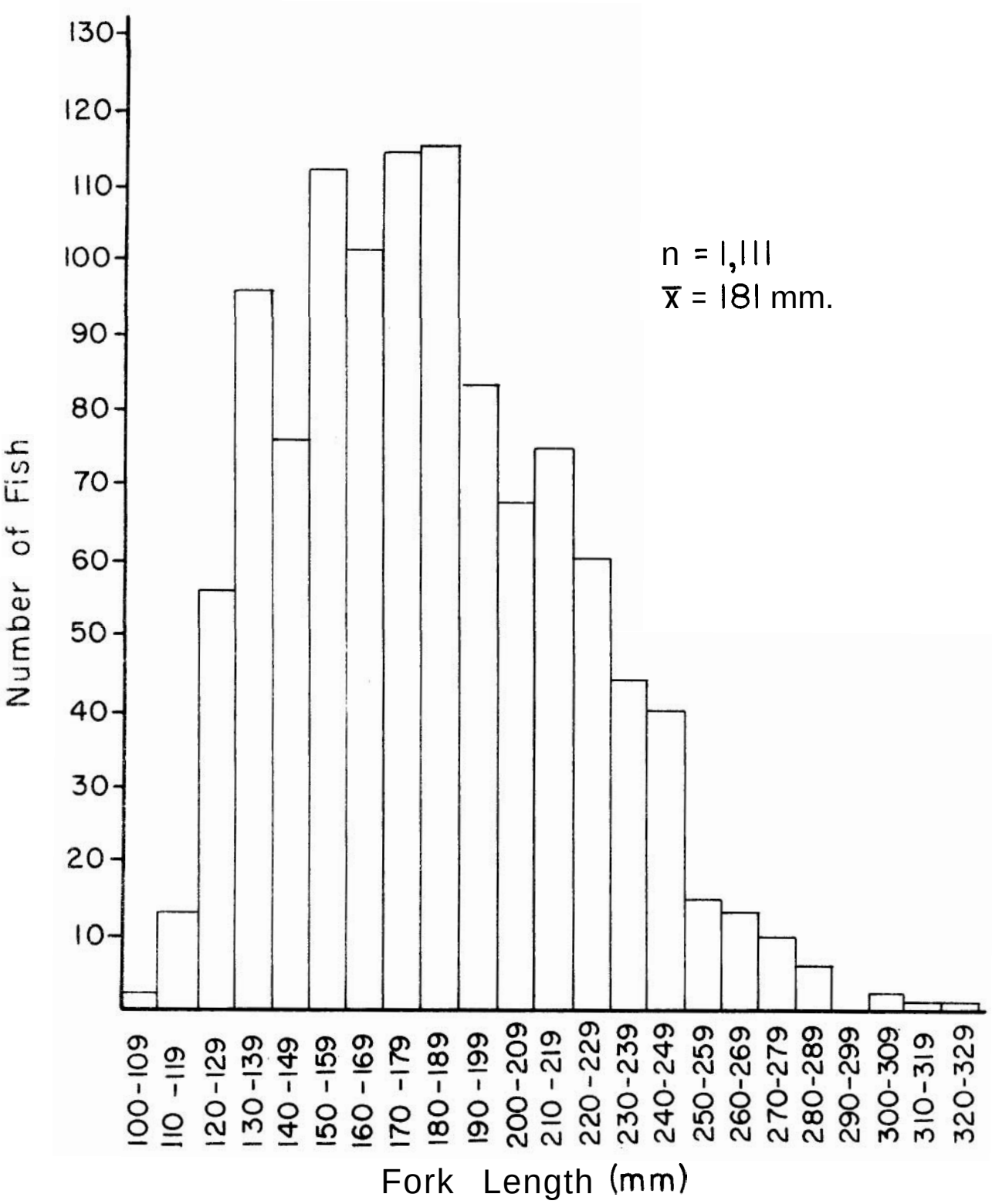

Table 5. Length frequency (in percent of sample) of 1,111 grayling from four sections of the Chena River, 1978.

Fork Length (mm)	Chena River Section			
	2a	2b	6	Dam Site
90-99				
100-109			0.5	
110-119		0.9	2.9	1.4
120-129	5.3	3.6	8.4	1.7
130-139	10.6	13.9	5.5	6.9
140-149	3.2	5.6	2.0	16.5
150-159	6.3	2.6	8.0	22.3
160-169	6.3	5.2	15.1	5.9
170-179	9.5	11.7	15.1	2.0
180-189	17.9	16.9	9.3	2.4
190-199	11.6	13.3	5.0	3.4
200-209	12.6	5.6	5.8	4.8
210-219	2.1	7.1	6.0	8.9
220-229	3.2	4.2	6.5	5.9
230-239	4.2	2.6	4.6	4.4
240-249	3.2	3.6	3.4	4.1
250-259	1.0	1.3	0.7	2.7
260-269	1.0	0.9	0.5	2.4
270-279	1.0	0.3	0.5	2.0
280-289	1.0	0.7	0.2	1.0
290-299				
300-309				0.7
310-319				0.3
320-329				0.3
330-339				
340-349				
n	95	308	416	292
$\bar{x}$	183	181	177.5	183
Range	122-284	115-287	105-280	110-325

the mean fork length in Section 2b is lower in 1978--181 mm (7 in) versus 190 mm (7.5 in) in 1977. Section 6 dropped from 190 mm (7.5 in) in 1977 to 177.5 (7 in) in 1978, and the area near the dam site is also down from 204 mm (8 in) mean fork length in 1977 to 183 mm (7.25 in) in 1978. Tn Section 2a, the mean fork length remained the same at 183 mm (7.25 in).

The mean fork length of the four sections combined is also down from 192 mm (7.25 in) in 1977 to 181 mm (7 in) in 1978, and the peak of the length distribution (Fig. 2) is lower in 1978, 150-190 mm (6.0-7.5 in) compared to the 170-210 mm (6.75-8.25 in) peak in 1977. What this may indicate is that the small fish which characteristically use the lower Chena for feeding and rearing may be redistributing themselves within the system due to changes in the lower river as outlined in the previous section on population estimates. Continued monitoring of these populations is needed to substantiate these theories.

Age determinations by scale analysis were made from a random sub-sample of 268 grayling (scales collected from every fourth fish captured). Age-length information presented in Table 6 shows that Age Class II was the predominant age group, accounting for 38% of the total sample, with Age Classes III and IV having 22% and 20.9% respectively. The mean fork length of the fish in the sub-sample was 188 mm (7.5 in). This corresponds relatively closely to the 181 mm (7 in) mean fork lengths of the original 1,111 samples shown in Fig. 2,

The capture frequency for Age Classes III through VII from 1973 through 1978 is shown in Table 7. Age Class III was the most abundant age captured for the forth straight year with 22.0%. Peckham, (1978) while sampling two sections of the Goodpaster River, also found Age III grayling to be the highest represented age class with 66% of the sample. Table 7 also shows comparative strengths of year classes of grayling from year to year. For example, Age Class III grayling in 1973 (60.5% of total) continued to show excellent year class strength at Ages IV, V, and VI with frequency percents of 44.1, 25.8, and 10.9, respectively.

Development Projects Affecting the Chena River

During the reporting period work continued on the Chena River Lakes Flood Control Project, presently under contract with the U. S. Army Corps of Engineers. The project is in its final phase of construction and completion is due in 1980. The Chena River at km 75 (mi 47), has been rechanneled to flow through a concrete control structure containing a series of four gates that in times of high water will be regulated to direct the excess flow of water from the upper Chena down a cleared floodway paralleling a 9 m (30 ft) earthen dike and out into the Tanana River, bypassing (and thus protecting) the City of Fairbanks from flooding.

The rechanneling of the Chena River through the control structure took place in October and November, 1978, and appeared to go smoothly.

Table 6. Age and length composition 268 ramdomly sub-sampled grayling captured in sections 2a,2b,6 and at the Chena River dam site, 1978.

Fork Length (mm)	Age Class I	II	III	IV	V	VI	VII	Total Number	Length Frequency Percent
100-109	2							2	0.7
110-119	5							5	1.9
120-129	9							9	3.4
130-139	18	4						22	8.2
140-149	4	10						14	5.2
150-159	1	18						19	7.1
160-169		25	1					26	9.7
170-179		16	2					18	6.7
180-189		19	6	2				27	10.1
190-199		8	13	3				24	8.9
200-209		2	7	1				10	3.7
210-219			15	8				23	8.6
220-229			8	12	1			21	7.8
230-239			4	14	1			19	7.1
240-249			3	6	1			10	3.7
250-259				7				7	2.6
260-269				2	3			5	1.9
270-279				1	2	1		4	1.5
280-289					1			1	0.4
290-299									
300-309						1		1	0.4
310-319									
320-329							1	1	0.4
N	39	102	59	56	9	2	1	268	
Age Frequency Percent	14.6	38.0	22	20.9	3.4	0.7	0.4		100.0
$\bar{x}$ Fork Length mm	128	167	206	230	256	290	325	188	

Table 7. Capture frequency by age class of grayling in the lower 80 km (50 mi) of the Chena River, 1973-1978.

Age Class	Percent Frequency						x Frequency
	1973	1974	1975	1976	1977	1978	
III	60.5	12.1	24.7	28.9	44.5	22.0	32.1
IV	18.0	44.1	13.5	15.2	8.3	20.9	20.0
V	3.0	24.8	25.8	9.3	5.7	3.4	12.0
VI	0.0	3.9	19.1	10.9	1.7	0.7	6.0
VII	0.5	0.3	2.2	1.5	0.0	0.4	0.8

The Corps of Engineers presented new data in 1978 on the necessity for a fish passage structure (ladder) for the Chena Dam. Analysis of these data by the various resource agencies associated with the project (the Alaska Department of Fish and Game, U. S. Fish and Wildlife Service, and the National Marine Fisheries Service) led to the conclusion that the ladder was of utmost importance, and the Corps was urged to follow the orginal plan incorporating a fish ladder into the control structure. This construction is scheduled for the summer of 1979.

LITERATURE CITED

Hallberg, J. E. 1977. Distribution, abundance and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1976-1977, Project F-9-9, 18(R-I): 23 pp.

Hallberg, J. E. 1978. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1977-1978, Project F-9-10, 19(R-I): 33 pp.

Peckham, R. D. 1978. Evaluation of Interior Alaska waters and sport fish with emphasis on managed waters, Delta District. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1977-1978, Project F-9-10, 19(G-III-I): 63-81.

Ricker, W. E. 1958. Handbook of computations for biological statistics of fish populations. Fish. Res. Board of Can., Narrain, B. C. Canada, Bulletin 119.

Roguski, E. A. and P. C. Winslow. 1969. Investigations of the Tanana River and Tangle Lakes grayling fisheries: migratory and population study. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1968-1969, Project F-9-1, 10:(16-B) 333-351.

Roguski, E. A. and Tack S. L. 1970. Investigations of the Tanana River and Tangle Lakes grayling fisheries: migratory and population study. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1969-1970, Project F-9-2, 11:(16-B) 303-319.

Tack, S. L. 1971. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3, 12(R-I): 35pp.

_____. 1972. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1971-1972, Project F-9-4, 13(R-I): 36 pp.

_____. 1973. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1972-1973, Project F-9-5, 14(R-I): 34 pp.

_____. 1974. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress 1973-1974, Project F-9-6, 15(K-I): 52 pp.

_____. 1975. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1974-1975, Project F-9-7, 16(R-I): 35 pp.

_____. 1976. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1975-1976, Project F-9-8, 17(R-I): 27 pp.

Van Hulle, F. D. 1968. Investigations of the fish populations in the Chena River. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1967-1968, Project F-5-R-9, 9:(15-B) 287-304.

Prepared by:

Jerome E. Hallberg
Fishery Biologist

Approved by:

Rupert E. Andrews, Director
Sport Fish Division

Mark C. Warner, Ph.D.
Sport Fish Research Chief